EFFECT OF DIFFERENT CHEMICAL PRESERVATIVES ON THE STORAGE OF SEA BUCKTHORN (HIPPOPHAE RHAMNOIDES L.) JUICE

Rentsendavaa CHAGNAADORJ[1]* , Furulyás DIÁNA[2] , Stéger-Máté MÓNIKA[3] and Babinszki-Székely DORA[4]

[1,2,3,4] Department of Food Preservation, Faculty of Food Sciences, Szent István University, Hungary
*Corresponding author: naado30@mail.ru

Abstract

Sea buckthorn (SBT) juice is one of the imperative products obtained from the SBT berries, is now commercially very important. The aim of this study was to comprehensively characterize the fruit quality trait of juice SBT cultivar (''Leikora'') grown in Hungary. Comparative studies on the effect of preservatives and storage on the overall quality of sea buckthorn berry blended juice were carried out. Juices were prepared from the juice of sea buckthorn and pomace of sea buckthorn by mixing their pomace in 9.9:0.1 (1%), 9.8:0.2 (1%) and 9.6:0.4 (4%). All the samples were packed in 210 ml transparent glass bottles and stored at ambient temperature. The samples were analyzed for TPC, pH, SSC and color measurement at zero storage and at an interval of 4 months up to 12 months. During storage TPC of C, P1, P2 and P3 samples decreased after 12 months from 2.2% to 32.9% and P3 samples increased 0.1%. After 4 months TPC each sample decreased from 13.81% to 30.36% compared with the initial months. After 12 months, SSC, pH, and color measurements increased significantly for sample P3, while samples C, P1, and P2 decreased significantly during storage.

Key words: *Hippophae rhamnoids***,** pomace, SSC, pH, color measurement

1. Introduction

The common sea buckthorn (*Hippophae rhamnoides L.*,) is the most widespread species of the genus *Hippophae* common in Europe, Asia, and North America. Sea buckthorn is a popular garden and landscaping shrub preventing soil erosion and reducing pollution (Li, Du, & Guo, 2015). Among the varieties of domestic fruit, sea buckthorn (*Hippophae rhamnoides*) recently has drawn attention to itself, because of its nutrient density of almost 200 active phytochemicals, among them unsaturated fats, carotenoids, and high amounts of vitamin C (Guliyev VB, Gul M, Yildirim A, 2004).

Many sea buckthorn products (juices, teas, liqueur, jams, personal care products, etc.) are on the market as niche products. During processing of sea buckthorn berries, high-quality press cakes (pomace) are generated as by-products. These residues of juice or oil production contain high amounts of valuable vitamins, flavonoids and special fatty acids, although there are high variations depending on season or cultivar (Cossuta et al., 2007). The commercial production of Sea buckthorn (*Hippophae rhamnoides*) juice results in a large amount of pomace, which is suggested to contain substantial amounts of valuable natural antioxidants. The pomace, one of the by-product of Sea buckthorn and end product of Sea buck- thorn berries, has been utilized in Russia in baking of bread and manufacturing of vitamin mixtures for farm animals and birds (Tsybikova G.Ts, et al., 2003). The polyphenolic rich berries and their products have been reported to inhibit the low-density lipoprotein (LDL) cholesterol oxidation and platelet aggregation, reduction of atopic dermatitis, immunomodulation, cytoprotective effects and protection from gastric ulcers((Yao and Tigerstedt, 1992; Guliyeva et al., 2004; Sabir et al., 2005a; Tiitinen et al., 2005)).

The sea buckthorn juice is yellow in color; the high amount of carotene is responsible for this yellow coloration. The presence of some of the other pigments also contributes to the color. Granules or clumps are embedded in the juice, which are actually the material containing spherical droplets that are yellow-brown in color (Beveridge and Harrison, 2001).

1. This study aimed to assess the stability of polyphenolic compounds in the SBT juice during storage conditions.
2. This study was aimed at evaluating the effect of storage time on some physicochemical properties of juice developed from Sea buckthorn berry.
3. The present study was carried out for the development of pomace-substituted juice from pomace of SBT and juice of SBT in the establishment of product shelf life and quality evaluation during storage.

2. Materials and methods

2.1. Sea buckthorn berries collection and processing

The berries of the sea buckthorn (*Hippophae rhamnoides* L.) cultivar ‘Ascola’ was collected from a commercial orchard (<u>North latitude 46° 57′ 28″, East longitude. 18° 51′ 53″</u>) near Nagyvenyim located in South Hungary in November 2017. The berries were cleaned to remove damaged, diseased, or pest-infected fruits.

2.1.1. Preparation of juice extraction

During the separation of juice, seeds, and shells of the berries we followed the technological process used in industrial practice (Fig.1). First, berries were heated to 80- 85°C next to continuous mixing to inactivate the enzymes. The berries were crushed with a mixer, and the juice was squeezed using a small-scale seed pressing device (GM-POO), during which the juice and the pomace were separated. After separated juice was added pomace from SBT berry. The treatment was made as Control (P0), SBT juice + pomace 1% (P1), SBT juice + pomace 2% (P2) and SBT juice + pomace 4% (P3). The drinks were filled into 210 ml transparent glass bottles, sealed and heated (90°C, 10min). Finally, all samples were cooled with the cool water bath and stored at room temperature for physic-chemical analysis at an interval of 4 months for a total period of 12 months.

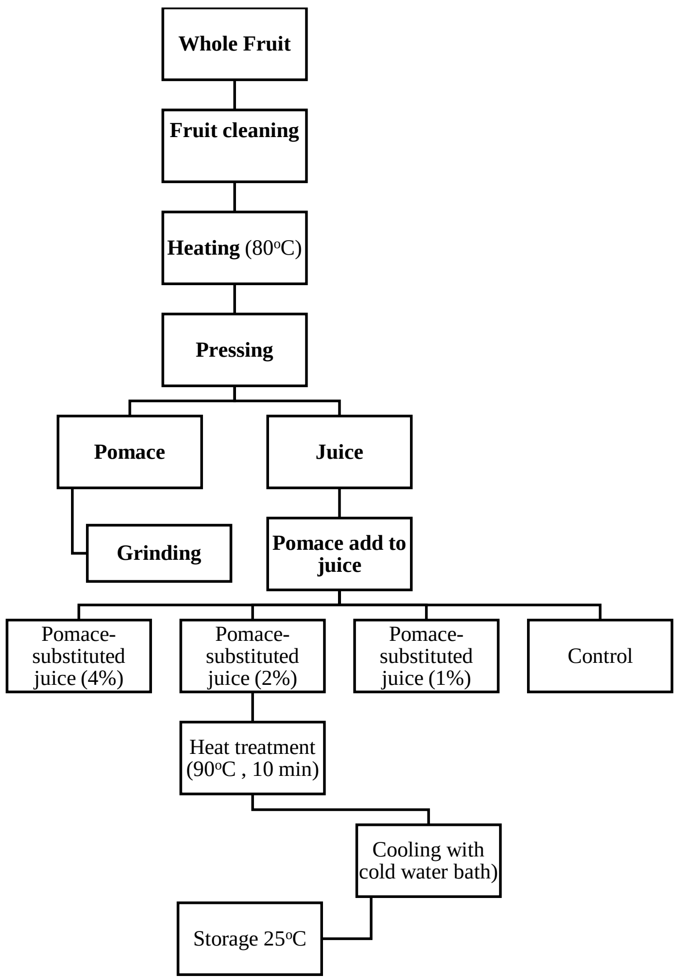

Figure 1. Processing flowchart for development of SB juice (Pomace-substituted juice)

2.2. Determination of total polyphenol content

The quantity of TPC (Total Polyphenol Content) is determined as described by Singleton and Rossi (1965) using Folin-Ciocalteu reagent. The colour change taking place during the reaction can be detected on 765 nm by spectrophotometer, and the results can be expressed as gallic acid equivalent (µg gallic acid/ml extract). All the reagents were analytical grade purchased from Sigma Aldrich Hungary Ltd. A Hitachi U-2900 UV-VIS spectrophotometer (Hitachi High-Technologies Europe GmbH, Krefeld, Germany) was used for photometric measurements.

2.3. Determination of colour measurement

The colour characteristics of the extracts are measured in C.I.E. colour measuring system based on the Konica Minolta CR-400 tristimulus handheld colorimeter. To calibrate the instrument, distilled water was used. During the measurement, L * (lightness factor), a* (red-green ratio) and b * (yellow-blue ratio) values were determined.

2.4. pH

Sample pH was determined in triplicate at room temperature using a Fisher Accumet, Model 15, pH Meter (Fisher Scientific, Edmonton, AB). Three-point calibration was accomplished employing pH 7.0, 4.0 and 2.0 buffers (Fischer Scientific).

2.5. Soluble Solids

Soluble solids were expressed as ºBrix and determined by refractometer. The fruit was thawed to 15 ± 5°C and juice was expressed by placing 3 to 5 fruit between two layers of cheesecloth and manually squeezing the sample. The ºBrix was determined on the juice using a Leica Auto Abbe refractometer, Model 10504 (Leica Inc., Buffalo, NY) with temperature compensation. Fruit samples were analysed in triplicate.

1. Result

The results of the study consisted of investigating changes in these variables taking place in the designed products after 2, 4 and 6 months of storage (20ºC). The following juices were examined: pomace-substituted juice (P1), pomace-substituted juice (P2), pomace-substituted juice (P3) and control (P0). The addition of 1, 2 and 4% of sea buckthorn pomace to Sea buckthorn juice caused extension. The total phenols content was assayed using the Folin-Ciocalteau reagent method and are presented in Table 1.

Table 1 Changes in total polyphenol content properties of SBT juice during storage at 20°C

№	TPC (µg/mL)	**Storage Interval** µg/mL (loss %)			
		Initial month	**After 4 months**	**After 8 months**	**After 12 months**
1	**P0 (0%)**	**1619.399**	**1336.586 (17.45%)**	**1642.801 (1.45%)**	**1085.362(32.98%)**
2	**P1 (1%)**	**1732.842**	**1206.797 (30.36%)**	**1949.921 (12.53%)**	**1253.938(27.64%)**
3	**P2 (2%)**	**1384.005**	**1192.869 (13.81%)**	**1818.857 (35.87%)**	**1062.984(23.19%)**
4	**P3 (4%)**	**1338.627**	**1123.553 (16.07%)**	**1980.243 (47.9%)**	**1309.177 (2.2%)**

Initially the TPC values of the samples (C to P3) was 1619.4, 1732.8, 1384, and 1338.6 µg/mL, which were gradually decreased to 1085.362, 1253.938, 1062.984 and 1309.177 µg/mL respectively after 12 months of storage. The mean TPC value decreased from 1619.399 to 1085.362 µg/mL during storage. For treatment maximum mean values were observed in sample P3 (1309.177µg/mL) followed by P3 (1060.9 µg/mL). Therefore, during storage maximum decrease was observed in sample P0 (32.98%) followed by P1 (27.64%), while minimum decrease was observed in sample P3 (2.2%) followed by P2 (23.19%) (Table 1). These results are in agreement with the findings of Castro-López et al.(2016) who reported an decrease in TPC in fruit juice preserved with chemical preservatives (Castro-López et al., 2016).

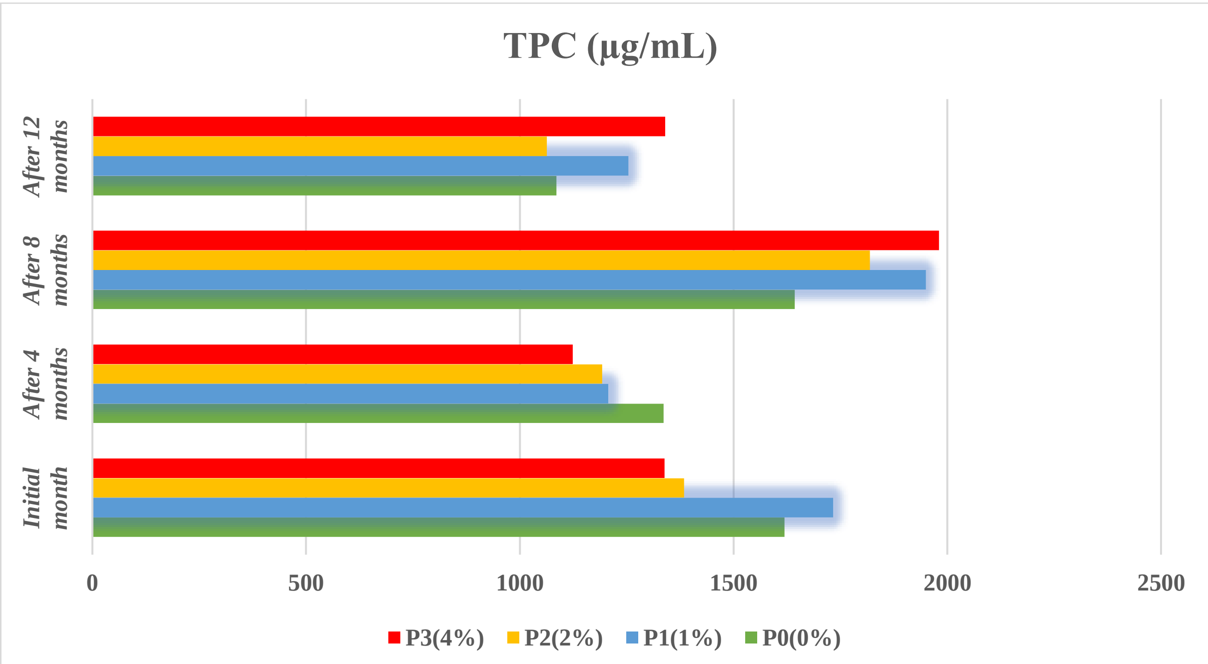

Fig 2. Total phenolic content of SBT juice during storage at 20ºC

The color measurement of the juice samples was measured using assayed using the Konica Minolta assays and are presented in Table 2. The L* values of samples (P0 to P3) on the initial day were same (47.9, 49.4, 47.4 and 44.9, which was each sample decreased to 38.5, 38.7, 37.8 and 39.0 respectively after eight months storage. Thus, after 12 months each sample increased from 15.08 to 17.6%. The mean L* values decreased from 6.26% to 8.23% during storage.

Table 2. Colour measurement of SBT juice during storage

Samples Pomace with SB juice	**Storage Interval**											
	After 2 months			**After 4 months**			**After 8 months**			**After 12 months**		
	L*	a*	b*	L*	a*	b*	L*	a*	b*	L*	a*	b*
C	**47.9**	**17.2**	**41.0**	**46.5**	**16.7**	**40.9**	**38.5**	**12.5**	**28.6**	**44.9**	**15.9**	**39.5**
P0.5	**49.4**	**17.1**	**45.2**	**45.2**	**15.7**	**40.9**	**38.7**	**11.8**	**28.9**	**45.5**	**14.8**	**40.5**
P1	**47.4**	**15.6**	**39.7**	**46.5**	**15.3**	**41.8**	**37.8**	**11.2**	**27.2**	**43.5**	**13.9**	**36.5**
P2	**44.9**	**14.6**	**40.4**	**45.2**	**13.4**	**37.6**	**39.0**	**11.4**	**28.9**	**45.3**	**13.9**	**39.5**

Initially the pH values of the samples (P0 to P3) was 2.35, 2.33, 2.42 and 2.47, which were gradually increased to 2.44, 2.45, 2.49 and 2.5 respectively during 12 months of storage. The mean pH value increased from 2.39 to 2.47 during storage. For treatment maximum mean values were observed in sample P3 (2.48) followed by P2 (2.44).

During storage after 4 months each sample increased from 0.81% to 4.29% and after 8 months all samples decreased from 1.61% to 3.75% (**Table 3**). Our results are consistent with the finding by Cecilia and Maia (2002), which did not observe significant differences in pH at 5% between a zero time of 350 days for the hot filling process.

Table 3. pH of SBT juice during storage

№	pH	Storage Interval				% Inc	Mean
		Initial day	After 4 months	After 8 months	After 12 months		
1	P0 (0%)	2.35	2.4	2.31	2.44	3.83	2.38^{d}
2	P1 (2%)	2.33	2.43	2.34	2.45	5.15	2.39^{c}
3	P2 (2%)	2.42	2.45	2.38	2.49	2.89	2.44^{b}
4	P3 (4%)	2.47	2.49	2.45	2.5	1.21	2.48^{a}
	Mean	2.39	2.44	2.37	2.47	-	-

Mean followed by different letters are statistically different ($P<0.05$) using LSD test

The SSC values of samples (P1 and P3) on initial day was 9.7 and 10.3^{o} brix, which were gradually increased to 10.2 and 10.4^{o} brix respectively during 12 months storage. After 8 months each sample increased from 1.87 to 5.73%. During storage maximum increase was observed in sample P1(5.15%) followed by P3 (0.96%), while maximum decrease was recorded in sample P2 (5.61%) followed by P0 (5.21%) (Table 4). SSC did not vary according on the type during storage. In fact, the variations found throughout storage time were no significant for either process or may have been caused by irrelevant factors.

Table 4. SSC of SBT juice during storage.

№	SSC (brix %)	Storage Interval (^{o} brix)				%	Mean
		Initial day	After 4 months	After 8 months	After 12 months		
1	P0 (0%)	9.6	9.0	9.42	9.1	5.21 dec*	9.28
2	P1 (1%)	9.7	9.9	10.28	10.2	5.15 inc**	10.02
3	P2 (2%)	10.7	9.7	10.29	10.1	5.61 dec	10.19
4	P3 (4%)	10.3	10.3	10.89	10.4	0.96 inc	10.47
	Means	10.08	9.73	10.22	9.95	-	-

dec*- Decreased %
inc**- Increased %

Conclusion

Sea buckthorn has various bioactive components with potential health benefits, including anti-diabetic, anti-obese, antioxidant and anti-inflammatory. It has been concluded from the present research work that the chemical preservatives have significant effect upon storage period and the sample prepared with combination of chemical preservatives remain acceptable till the end of this research work.

The presence of valuable chemical and nutritionally important constituents in sea buckthorn juice, and from the scientific knowledge of their importance, it is clear that sea buckthorn juice is one of the most important sources of these materials, and can be use as alternative nutritional sources in the commercial market. The result of the control experiment was higher than the others every month. The following study plan which compound of TPC changes during storage.

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